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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/659,484	09/11/2000	Takeshi Takagi	0819-374	9022

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EXAMINER

LOUIE, WAI SING

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 08/18/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/659,484

Applicant(s)

TAKAGI ET AL.

Examiner

Wai-Sing Louie

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 10 and 11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 10 and 11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 12.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-6, 8, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jorke (US 5,798,539) in view of Liu et al. (US 6,031,256) and Yamazaki (US 5,440,152).

With regard to claims 1, 8, and 10, Jorke discloses a bipolar transmitter, HBT, (col. 2, line 66 to col. 4, line 36 and fig. 1a) comprising an emitter layer 4 containing an impurity of a first conductivity type, a base layer 3 containing an impurity of a second conductivity type, and a collector layer 3 containing a impurity of the first conductivity type, the bipolar transmitter having:

- Jorke does not disclose a high-concentration doped layer, which is a barrier layer and the material composition is the same as the emitter layer, being provided in the emitter layer and doped with the impurity of the first conductivity type at a higher concentration than in the emitter layer. However, Liu et al. disclose a superlattice confinement layer 26 interposed between the two semiconductor emitter layers 24 and 28 (fig. 1). The superlattice confinement having a plurality of undoped well layer and a plurality of highly doped barrier layer (Liu col. 3, lines 30-35). The doping concentration of the barrier layer is higher than the

emitter layer 24 and the material of the barrier is the same as the emitter layer 24 (Liu col. 3, lines 30-35). Liu et al. teach the superlattice layer 26 improves carriers (holes) confinement (Liu col. 2, lines 20-33), increase the speed, and lower the power consumption of the HBT (Liu col. 2, lines 9-19). Therefore, it would have been obvious at the time the invention was made to modify Jorke's device with the teaching of Liu et al. to provide a superlattice confinement layer having a high-concentration doped layer in order to improve carriers (holes) confinement, increase the speed, and lower the power consumption of the HBT.

- Jorke discloses a SiGe base layer 3, but does not disclose the Ge composition ratio is graded though out the layer. However, Yamazaki discloses the base layer 10 is SiGe, where the Ge concentration is graded (Yamazaki col. 7, lines 37-46). Yamazaki teaches crystal defects would be effectively restrained with the graded Ge content in the base layer (Yamazaki col. 2, lines 13-25). Therefore, it would have been obvious at the time the invention was made to modify Jorke's device with the teaching of Yamazaki to provide a graded SiGe base layer in order to restrain the crystal defects. Yamazaki disclose the Ge concentration changes from the collector layer interface toward the emitter layer (Yamazaki col. 7, lines 30-50).

With regard to claims 2-3 and 6, Jorke discloses the base layer 3 containing an impurity of a second conductivity type, the base layer is delta-doped have a thickness only a few nm (col. 3, lines 28-31). Jorke discloses the dopant concentration is 10^{14} cm^{-2} (col. 3, line 21). The doping

density within this few nanometers can be calculated to about 10^{20} cm^{-3} , which is much higher than the emitter doping concentration (see col. 3, line 36).

With regard to claim 4, Jorke discloses the cap layer 5 has higher-concentration doping, which has more than ten times higher than the concentration of the emitter layer 4 (col. 3, lines 35-43).

With regard to claim 5, Jorke, modified by Yamazaki in claim 1 above, would disclose a pn-junction from at the interface of emitter/base junction and a diffusion (depletion) region 13 is formed adjacent to the high-concentration doped base layer (Yamazaki col. 6, lines 37-40).

With regard to claim 11, Jorke does not disclose the distance between the high-concentration doped layer and the base layer is 40 nm or less. Since the applicant has not established the criticality of the thickness stated and since the thickness is in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use these value in the device. Where patentability is said to be based upon particular chosen dimension or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jorke (US 5,798,539) modified by Liu et al. (US 6,031,256) and Yamazaki (US 5,440,152) as applied to claim 1 above, and further in view of S. M. Sze in *Physics of Semiconductor Device*, 2nd Edition, 1981.

With regard to claim 7, Jorke discloses the emitter layer 4 is made of silicon and the base layer 3 is made of SiGe, but does not disclose the emitter layer 4 has wider bandgap than the base layer 3. However, S. M. Sze discloses the bandgap energy of Si is 1.12 eV and Ge is 0.66 eV. Therefore, it would have been obvious that pure Si emitter layer 4 has wider bandgap energy than the SiGe base layer 3.

Response to Arguments

Applicant's arguments filed 7/24/03 have been fully considered:

- Applicant argues that the layer 5 in Jorke is not the high-concentration doped barrier layer of the prevent invention and is not interposed between the two semiconductor layers. Applicant is correct. The present rejection is based on a newly cited reference Liu et al. that teach a superlattice confinement layer in the emitter. This will meet the limitations of amended claim 1. Please see the rejection above.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the

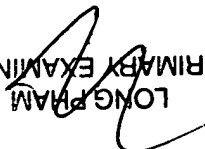
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organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

wsf
August 7, 2003


LONG PHAM
PRIMARY EXAMINER


LONG PHAM
PRIMARY EXAMINER